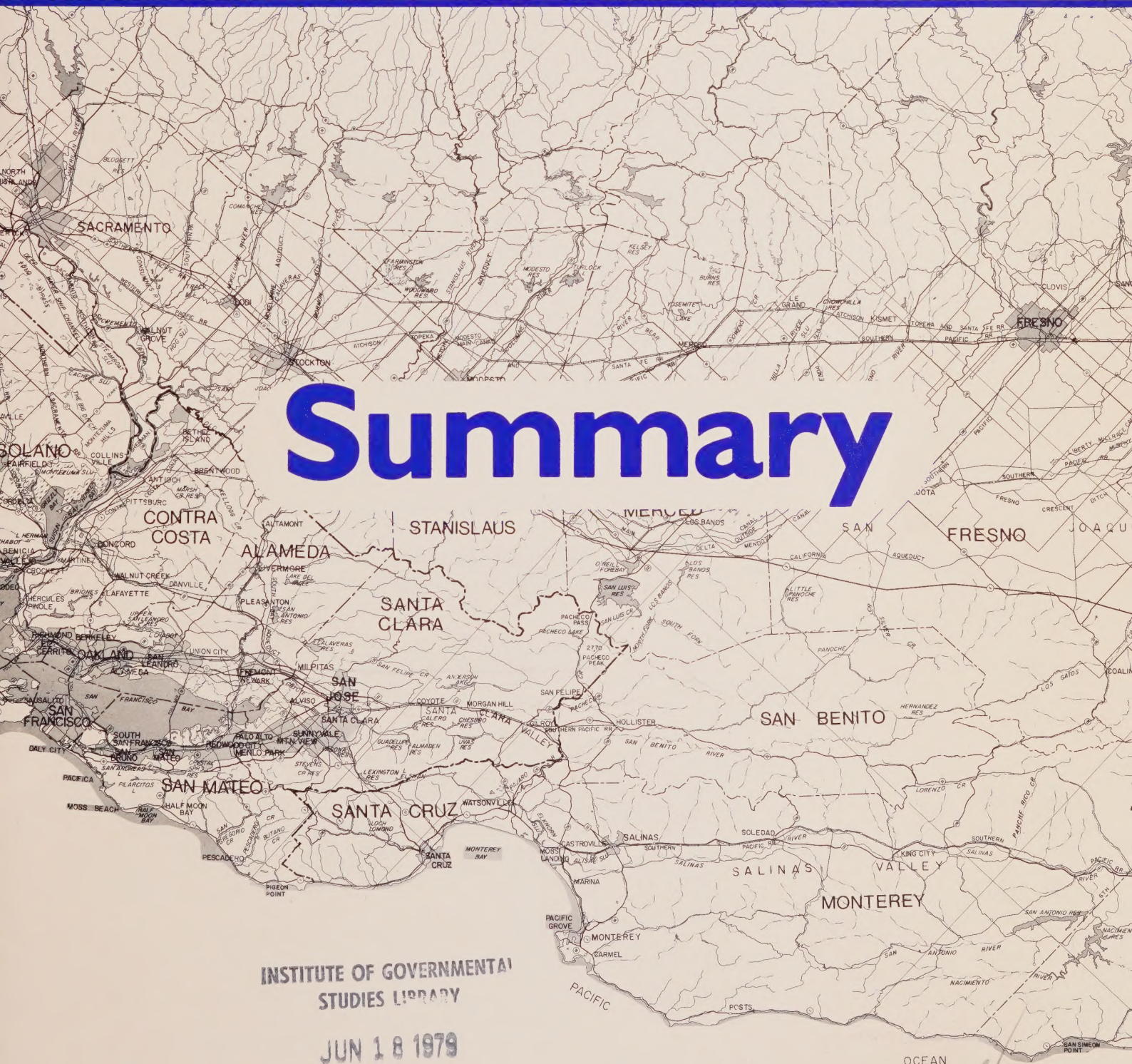


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San Francisco Bay Area **Regional Water Reuse Study**

Summary




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SUMMARY OVERVIEW

There were two fundamental questions to be answered in Phase I of the San Francisco Bay Area Regional Water Reuse Study (WRS): (1) Is there a market for large scale wastewater reuse? and, (2) should the WRS continue into Phase II?

The answer to the first question is definitely yes. In fact, the potential markets far exceed the available supply. However, the markets are dependent on a pricing structure which would make the price of reclaimed water competitive with alternative sources.

The answer to the second question is also yes. California needs more water. Many of the present and future demands can be met using reclaimed Bay Area wastewater. In addition, the cost to deliver reclaimed water to potential use areas is competitive with proposed new conventional sources of supply in the state.

By 1985, there will be 440,000 acre feet per year (ac-ft/yr) of highly treated wastewater available for export from the Bay Area. This is a significant source of supply, but not enough to meet all the potential markets.

Phase I has concluded that the following markets have the greatest potential for using reclaimed water on a large scale:

- Salinity control in the western Delta (300,000-600,000 ac-ft/yr).
- Multiple uses in the western Delta, including Suisun Marsh management (150,000 ac-ft/yr), powerplant cooling (30,000 ac-ft/yr), and agricultural use in Solano County (100,000 ac-ft/yr).
- Irrigated agriculture in the northern San Joaquin Valley, possibly by providing additional treatment and blending reclaimed water into the Delta-Mendota Canal.
- Irrigated agriculture in the southern San Joaquin Valley, (up to 600,000 ac-ft/yr for the western portions of Merced, Fresno, Kings and Kern Counties).

Regional projects must be based on supplying a major market such as salinity control in the Delta, Suisun Marsh enhancement, or agricultural use. Many smaller, worthwhile reuse projects (aquaculture, silviculture, creation of new wildlife habitat, etc.) can be considered along with a regional project, but cannot justify the expense in themselves. All of the major markets are outside of the immediate Bay Area.

Nearly all of these potential uses represent existing or planned uses of the freshwater resources of the state. (The only exceptions are portions of the potential market in Fresno and Kings Counties.) That is, they do not represent new demands for water. Thus, meeting these uses with reclaimed water makes additional freshwater available for other purposes.

Major reuse markets are all east of the Bay Area, and

geography dictates only three practical transport routes to these markets--a shoreline or underwater route through Carquinez Straits into the Delta, the Altamont Pass or the Pacheco Pass into the San Joaquin Valley.

Preliminary cost estimates (capital and O&M) were prepared for the required pumping, conveyance, storage, additional treatment (in some cases) and related facilities. Costs to provide reclaimed water to these major markets could range as follows:

- \$135-\$165/ac-ft for uses in the western Delta.
- \$265-\$310/ac-ft for uses in the northern San Joaquin Valley, including additional treatment for unrestricted agricultural use.
- \$330-\$340/ac-ft for use of secondary effluent by agriculture in the southern San Joaquin Valley. (In this case no additional treatment is required, because most crops in the area do not require it.)

Since the California Department of Water Resources estimates the next "conventional" supply, a new dam, will cost approximately \$110-\$300/ac-ft, the cost of reclaimed water is comparable.

There are, of course, major issues and questions to resolve before any large-scale project can be implemented:

- The feasibility of financing a major reuse project must be determined.
- A pricing method for users of reclaimed water must be established.
- A series of technical issues must be resolved:
 - ☐ What is the feasibility of salinity control in the Delta using reclaimed water?
 - ☐ What additional treatment will be required to meet Health Department unrestricted agricultural use requirements?
 - ☐ What is the feasibility of blending reclaimed and freshwater in the Delta-Mendota Canal?
 - ☐ Is it feasible to use reclaimed water to maintain the Suisun Marsh?
 - ☐ How can salt balance and drainage problems in potential agricultural use areas be resolved?
- Legal and water rights issues must be resolved.
- Institutional issues and implementation procedures must be established.

Phase II of the WRS will focus on those major markets which have the greatest potential for beneficial use, considering the total water resources of California.

STUDY OBJECTIVES & ORGANIZATION

The San Francisco Bay Area Water Reuse Study is a 2-phase study to develop a regional long-range wastewater reclamation facilities plan. The plan is to provide for the maximum reuse of Bay Area wastewater, and include an implementation program consistent with on-going and proposed sub-regional programs.

In Phase I, the goals were to:

- Identify the major potential markets for reuse of Bay Area wastewater.
- Provide an updated characterization of wastewater sources in the nine-county Bay Area.
- Evaluate and update previously studied regional water reclamation projects.
- Identify specific implementation constraints of wastewater reuse and propose methods to overcome or resolve these constraints.
- Identify and recommend specific projects for additional study in Phase II.

It is the intent of Phase I to present a general assessment of issues, so that Phase II can be directed toward the analysis of specific alternatives.

The study is sponsored by a fourteen member Joint Powers Agency led by the East Bay Municipal Utility District. Other major agencies involved in the study include:

- City and County of San Francisco
- Central Contra Costa Sanitary District
- Santa Clara Valley Water District
- Contra Costa County Water District
- East Bay Dischargers Authority
- South Bay Dischargers Authority
- California Department of Water Resources
- U.S. Bureau of Reclamation
- Environmental Protection Agency
- California Regional Water Quality Control Board - San Francisco Bay Region
- California Department of Health Services
- California State Water Resources Control Board, Office of Water Recycling
- Association of Bay Area Governments

A Policy Board consisting of representatives from each of the participating agencies oversees the study. A Staff Review Committee, also made up of representatives of each of the participating agencies, provides technical assistance, advice, and recommendations.

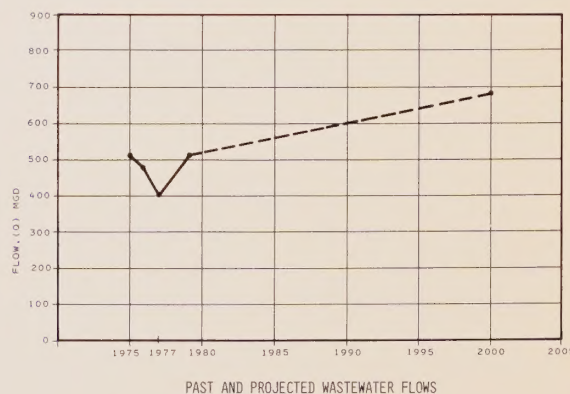
A team of consultants headed by CH2M-Hill in association with Jefferson Associates, Inc., Jordan/Avent and Associates, and Dodson and Young are performing the study. The Study Manager is Philip Hall, Vice President and San Francisco Regional Manager of CH2M-HILL.

RECLAIMED WATER RESOURCES

Information regarding the sources and characteristics of wastewater was developed to provide a rational basis for determining the feasibility of various reuse alternatives and the marketability of the reclaimed water. Available data on characteristics of 31 municipal wastewater plant effluents, selected on the basis of their size and location, were collected and analyzed.

The estimated 1978 average flow of effluent from the study area is approximately 510 MGD, with the largest contributors being the South Bay, East Bay and San Francisco subregions which make up 60 percent of the total.

Wastewater flows for each municipal discharger were projected to the year 2000 using State Department of Finance population projections. The projections indicate that by 1985 the average flow from the study area will be approximately 560 MGD, and by the year 2000 it will increase to 680 MGD. The diagram below represents a plot of the past and anticipated future wastewater flows for the study area. The effect of the 1976-77 drought is apparent, as is the gradual 1.2 percent per year increase in flows expected throughout the entire Bay Area until the year 2000.



At the present time, there are approximately 33 reuse projects operating in the study area, providing about 16,000 ac-ft/yr of reclaimed water. Most of the ongoing reuse projects are relatively small, have developed near treatment plants, and generally involve landscape and agricultural irrigation.

With the availability of funds for studies of water reuse and the increased awareness of California's need for more water as a result of the drought of 1976-1977, there has been a growing interest in local reuse projects. Currently, within the study area there are over 20 reuse projects in the planning stage. The estimated future reuse quantity for the region is 100,000 ac-ft/yr.

MARKET EVALUATION

The market identification effort proceeded along two parallel paths. The first involved the collection of data from various federal, state, and local agencies, and the computation of water demands by use and location from the data supplied. Demands were computed for 1985 and 2000. The second approach involved interviewing potential reclaimed water users to assess their interest, attitudes, and specific concerns about reclaimed water.

The analysis indicated that agricultural use, especially that of non-food crops, constitutes the most significant water demand. Salinity control, recreation and wildlife, and marsh enhancement represent large, constant, concentrated demands. Landscape use is localized, while present silvicultural requirements are relatively small at a regional level, although there is future potential for more silviculture to provide fiber and fuel from trees. Industrial use, although substantial, remains steady or declining. This reflects an increased in-plant recycling capability which will result in a lessened dependence on outside freshwater sources to meet growing industrial needs.

The markets identified in Phase I could use two to three times the amount of reclaimed wastewater available from the Bay Area. Because of this, priorities may be required for allocating wastewater among competing uses.

IDENTIFICATION OF PROJECT ALTERNATIVES

Alternative projects were formulated by posing three questions.

- What and where are the markets?
- Where is the wastewater?
- How can it be delivered?

An overriding factor in determining potential markets was whether they were significant enough in terms of size and importance to warrant transport of wastewater from the Bay Area on a regional basis.

The significant markets identified were salinity control, marsh enhancement, powerplant cooling in the Delta, and irrigated agriculture in the San Joaquin Valley. Industrial reuse did not appear to be a significant market for a regional project because of the relatively small amounts needed and the distance required for transport. However, industrial reuse could well be a secondary market for a specific regional project by delivering the water enroute to a primary market. This is also a possibility for other secondary markets represent-

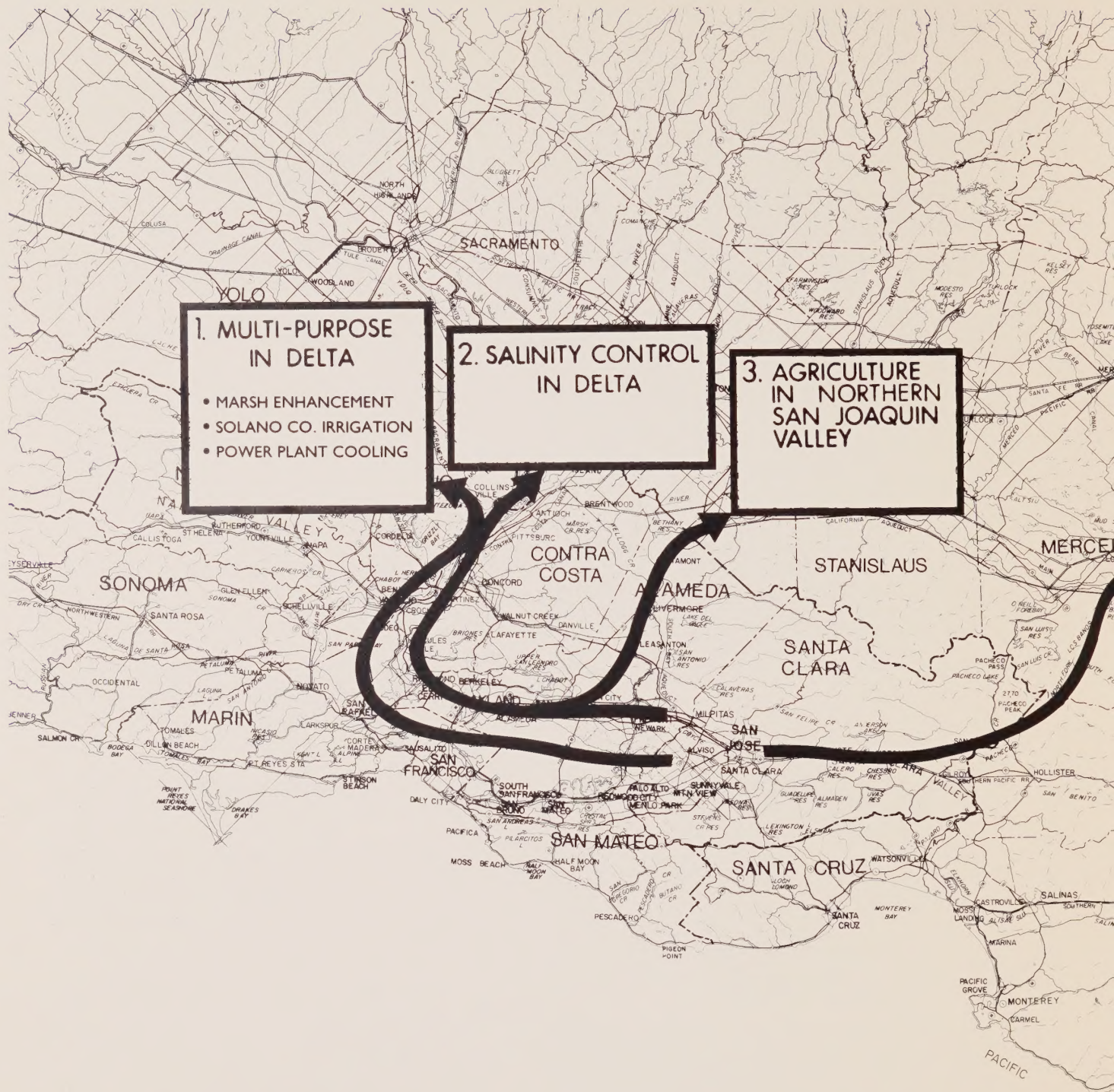
ing several types of reuse: landscape irrigation, silviculture, aquaculture, and other similar uses.

Given the above principal markets and the known location of sources in the Bay Area, five routes were selected as possibilities for transporting the wastewater to the Delta and/or the San Joaquin Valley:

- North Bay
- Sub-bay (a submerged line under the Bay)
- East Shore
- Altamont Pass
- Pacheco Pass

Using these five basic routes, 16 potential projects were developed for assessment. By comparing the costs and significant issues associated with the various combinations of elements, four market/project concepts were identified for further study. The selected market/project concepts are indicated below and a more detailed description of each follows:

- Multipurpose use in the Delta
- Salinity control in the Delta
- Agriculture in the northern San Joaquin Valley
- Agriculture in the southern San Joaquin Valley



**1. MULTI-PURPOSE
IN DELTA**

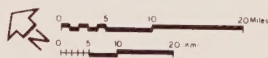
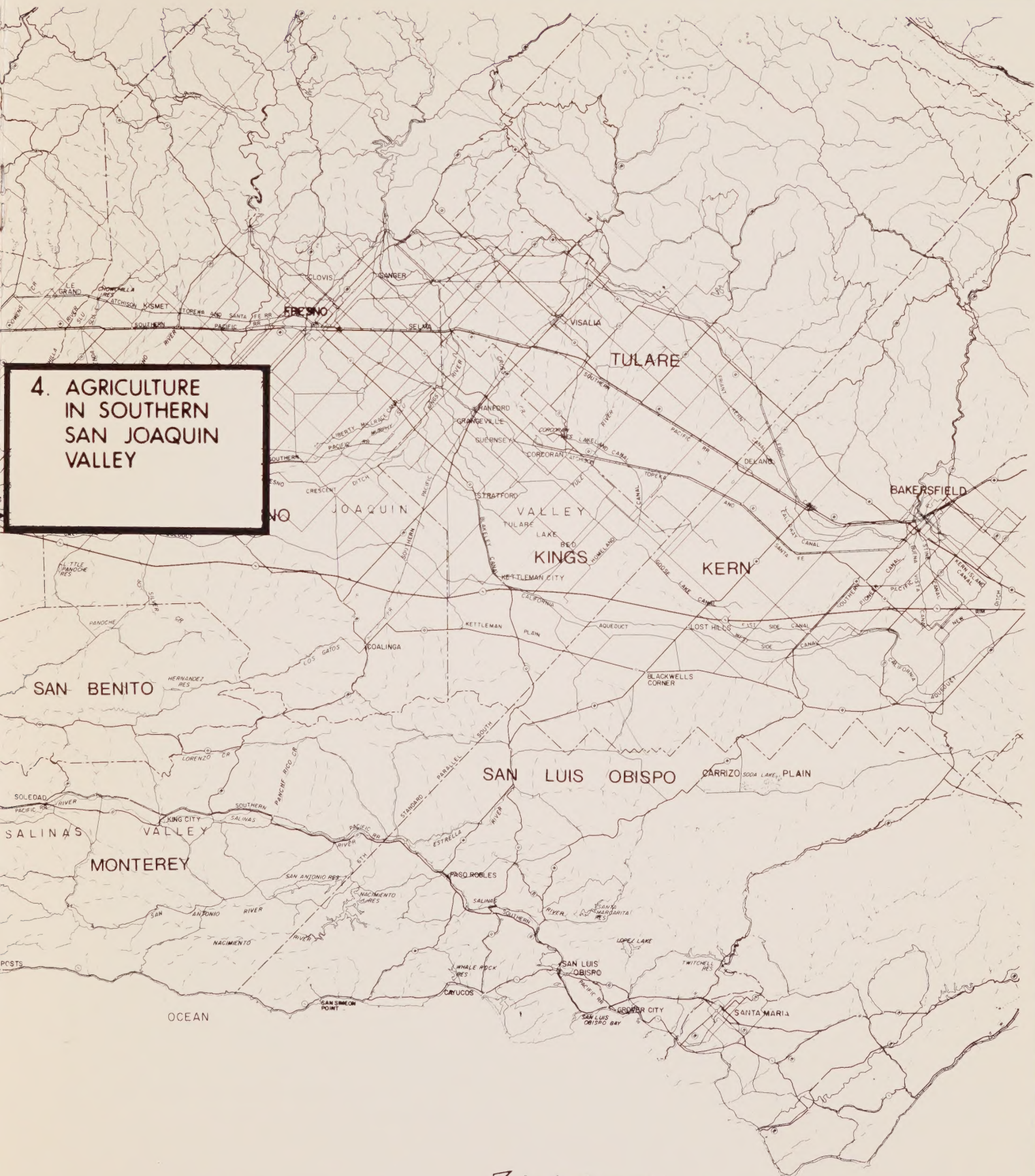
- MARSH ENHANCEMENT
- SOLANO CO. IRRIGATION
- POWER PLANT COOLING

**2. SALINITY CONTROL
IN DELTA**

**3. AGRICULTURE
IN NORTHERN
SAN JOAQUIN
VALLEY**

MARKET PROJECT CONCEPTS

4. AGRICULTURE
IN SOUTHERN
SAN JOAQUIN
VALLEY



MARKET/PROJECT CONCEPT 1

MULTIPURPOSE USE IN THE DELTA

This alternative is a multipurpose market in the northwestern Delta area. The reclaimed water would serve demands for Suisun Marsh management, powerplant cooling and irrigation in Solano County.

Providing additional water to Suisun Marsh will enhance the wildlife environment by providing more food and cover for water fowl. Reclaimed water for agricultural irrigation will result in a net gain in crop income due to changed cropping patterns and increased yields on lands otherwise dry-farmed, inadequately irrigated, or suffering losses in dry years. Reclaimed water would also be available for PG&E's proposed coal-fired power-plant site in Solano County.

This alternative would serve existing or planned irrigated lands. The powerplant (if located in Solano County) would require an equivalent amount of freshwater if reclaimed water is not used. The supply for Suisun Marsh would be an additional quantity to augment existing water supplies used for marsh management.

Two route options for delivery to the northwestern Delta were examined for this concept. The first route utilizes a submerged pipeline running in shallow water north and east along the East Bay to Rodeo. From Rodeo to a river crossing near Chipps Island and then to Solano County the pipeline is located on land in Contra Costa County. The second route conveys reclaimed water to Solano County via an onshore pipeline at low elevation in the East Bay. Both systems would require no storage due to the complimentary demand timing exhibited by the three uses. Expected costs to convey water for these uses range from \$145 to \$165/ac-ft.

Both the powerplant cooling and irrigation uses are water demands which could be met by reclaimed water. The implementation of this project depends to some extent on the final location of the powerplant, and in large part on the availability of alternative supplies for irrigation. The suitability of marsh management using reclaimed water is still under investigation by the U.S. Bureau of Reclamation, California Department of Water Resources and other agencies.

MARKET/PROJECT CONCEPT 2

SALINITY CONTROL IN THE DELTA

This alternative would provide salinity control in the western Delta by direct input of reclaimed water into channels near Chipps Island.

The use of reclaimed water for Delta outflow will improve water quality and protect fish and waterfowl, particularly in dry years when adequate freshwater releases are not assured. The reduction in salinity resulting from the use of reclaimed water might be measured in units of freshwater requirements to achieve the equivalent effect. The Suisun Marsh will also benefit from Delta outflow. Benefits can be measured in terms of increased population of fish and wildlife species, use for hunting, and recreational visitation. The benefit would be a function of the amount of resources conserved and the acres of unique habitat preserved.

Freshwater from existing supplies in the Delta is now being used to maintain a minimum Delta outflow. The use of reclaimed water for salinity control could replace some of this freshwater and make it available for a higher and better use.

Two delivery options to Chipps Island are the sub-bay and East Shore systems, similar to those for Market/Project Concept 1. The project ends at Chipps Island rather than continuing into Solano County, thus decreasing the project costs to the range of \$135 to \$145 per acre foot. Additional treatment may be needed to meet water quality requirements related to toxicity or biostimulation concerns. These costs are not included.

Two major factors have recently reduced the estimated yield of the Central Valley Project (CVP) and State Water Project (SWP): The 1976-77 drought and the recent SWRCB Decision 1485 which set water quality standards for the Delta. These reductions in yield, plus the existing contractual commitments of both projects, make it apparent that more supply is needed in the Delta.

Both the SWP and CVP recognize this need for more water. Reclaimed water would seem to be an excellent source, particularly since the cost is reasonable in comparison with alternative conventional sources.

MARKET/PROJECT CONCEPT 3

AGRICULTURE IN NORTHERN SAN JOAQUIN VALLEY

This alternative serves agricultural irrigation demands in the northern San Joaquin Valley by blending in the Delta-Mendota Canal or by using a new conveyance. The use of reclaimed water for irrigation could prevent losses in crop income during dry years. An indirect benefit may be realized in the food processing industry in below normal rainfall years if income and wage losses are reduced. If the blending of reclaimed water results in a less expensive source of irrigation water, the savings will be a benefit, as will the value of the nutrients in the water compared to the cost of fertilizer replaced. This alternative could postpone construction of other new water supply facilities.

Reclaimed water conveyed to the northern San Joaquin Valley via the Altamont Pass could follow the Southern Pacific Railroad (SPRR) alignment through Niles to Pleasanton. From Pleasanton, the pipeline would continue along the North Bay Aqueduct alignment to a reservoir in Brushy Creek.

Costs associated with this alternative range from \$265 per acre foot to \$310 per acre foot. This includes an allowance for additional treatment to meet state health standards for unrestricted agricultural use.

There is an adequate water supply for existing use in the northern valley and the market study revealed no immediate need for additional water. However, there are areas of groundwater overdrafts in these areas. This project concept would certainly encounter public health concerns, and possible resistance from farmers if the quality of the blended water is significantly lower than they would otherwise receive. For these reasons, this alternative concept may have a lower implementation feasibility than the others. However, by incorporating the reclaimed wastewater as a new source for the Central Valley Project, it is possible that facility costs could be incorporated into the costs and repayment of that project.

MARKET/PROJECT CONCEPT 4

AGRICULTURE IN SOUTHERN SAN JOAQUIN VALLEY

This alternative serves restricted agricultural irrigation demands in the Santa Clara Valley and southern San Joaquin Valley. Irrigation water that is locally available in the southern San Joaquin Valley is of marginal quality and in some locations of insufficient quantity. Benefits of this project would include the net gain in crop income from increased crop yields resulting from adequate irrigation of lands now under-irrigated, increased crop production by irrigating lands presently dry-farmed, prevention of losses in dry years due to source reliability, reduced frost damage, and the change to higher-value crops made possible by better quality water. The nutrients that exist in the water will reduce the need for expensive fertilizer.

If an interchange with the San Felipe Project could be established, the quantity of the San Felipe water intended for irrigation use in the Santa Clara Valley might be reduced.

The delivery system to the San Joaquin Valley via the Pacheco Pass would follow the Western Pacific Railroad south to Highway 101 below San Jose and then continue to Gilroy. From Gilroy the pipeline would head southeasterly through Dunneville and up Arroyo de las Veboras to a tunnel which daylight at Los Banos Creek. A reservoir would be constructed on Los Banos Creek to store the water when not needed for irrigation. Projected cost for this alternative range from \$330 to \$340 per acre foot.

PHASE II CONCEPTS

The overall approach for Phase II of the Water Reuse Study is illustrated in the diagram shown below. The study is continuing with a phased approach and the Policy Board has given its initial authorization for Phase IIA. This phase is the evaluation of key issues and the screening of alternatives giving consideration to the four market/project concepts identified in Phase I, plus a "no project" alternative.

Phase IIA will proceed immediately with studies of key issues which have been identified in Phase I. Typical of the issues to be studied are the following:

- Treatment requirements for discharge into the Delta
- Sources of financing for large-scale reuse projects
- Case studies of large-scale agricultural reuse in the San Joaquin Valley
- Cost of new conventional water supplies in California.

Issue papers providing in-depth discussion and analysis, will be prepared for these and other key topics of concern. They will constitute the basis of a detailed framework on which to screen and

evaluate alternative projects.

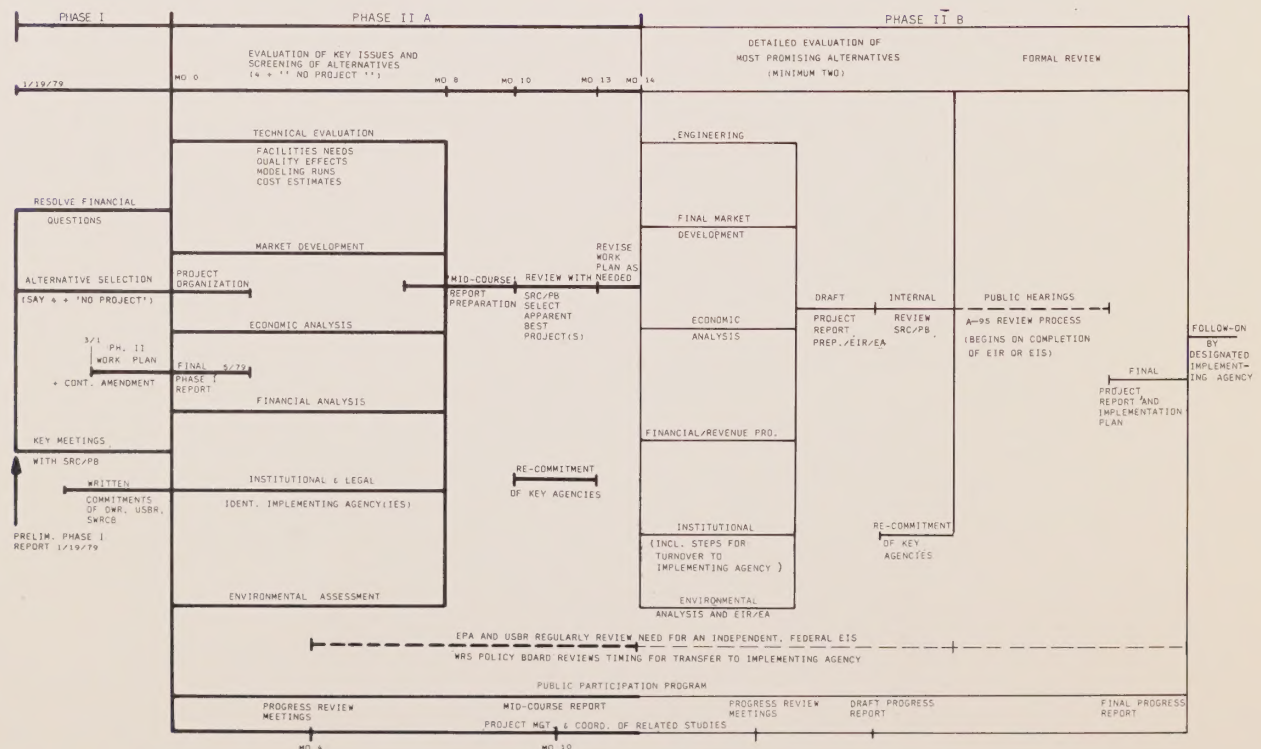
Phase IIB will be the detailed evaluation of two or more of the most promising alternatives plus the "no project" alternative identified in Phase IIA. These alternatives might include the following:

- The best regional reuse project in the Delta
- The best regional reuse project for irrigated agriculture in the San Joaquin Valley
- A mix of present concepts integrating the best elements of each
- The "no project" or "local reuse only" alternative.

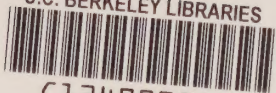
Public participation will be an integral part of Phase II. The participation program will strive for a high degree of visibility, and will include public consultation such as information meetings and workshops, and Policy Advisory Committees.

At the conclusion of Phase IIB a final project report and implementation plan would be prepared. Following this, an implementing agency such as the U.S. Bureau of Reclamation or the California Department of Water Resources or both, would proceed with feasibility studies, final design, and construction.

PHASE II SCHEDULE



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